

ANIMAL PRODUCTION PORTFOLIO

Knowledge Area 301: Reproductive Performance of Animals

Highlights of FY2004 CSREES Investments (\$14.4 million)



USDA Goal 1:
Enhance Economic Opportunities for Agricultural Producers

CSREES Objective 1.5:
Contribute Science-Based Information, Analysis, and Education to
Promote the Efficiency of Agricultural Production Systems

Ubiquitin: A Novel Fertility Marker in Males:

Research conducted at the **University of Missouri** found that ubiquitin, a small, chaperone protein binds to abnormal sperm during passage through the male reproductive tract. Ubiquitin also controls the destruction of sperm mitochondria after fertilization. A novel, rapid, and inexpensive test for assessing fertility in bulls, boars, and stallions was developed. (NRI grant; CRIS Accession Number 0192806)

Microfluidic Device for Assisted Reproduction:

Investigators at **Micro Agri Systems, Inc** have developed a manufacturing process for a prototype microfluidic culture device for *in vitro* maturation (IVM), *in vitro* fertilization (IVF), and *in vitro* embryo culture (EC) of bovine embryos. The microfluidic culture environment will lead to further advances in assisted reproductive technologies because fewer sperm can be used to optimize fertilization and the local environment can be more tightly controlled to optimize early embryonic development. (SBIR Phase I and Phase II grants; CRIS Accession Number 0189986)

Vitamin A Enhances Embryo

Development: Scientists at the **University of Tennessee** conducted studies to determine when, where, and how retinol (vitamin A) and its natural cellular metabolite (retinoic acid) affect oocyte maturation and early embryonic development in cattle and sheep. Results of their studies revealed that vitamin A is an indicator of ovarian follicular health; vitamin A improves embryonic developmental competence; vitamin A treatment during *in vitro* oocyte maturation improves subsequent embryonic development; and vitamin A protects *in vitro* derived embryos from oxidative stress. (Hatch; CRIS Accession Number 0188217)

Management Practices Increases Pregnancy Rates in Cattle: Fertility in dairy cows has been decreasing at the rate of 1% per year since ~1970. Relatively few beef producers (5-10%) use artificial insemination to take advantage of genetically superior sires. Members of the **NC-1006 multi-state committee** have developed management practices and hormone treatments to synchronize ovulation and timed artificial insemination in beef and dairy cattle. These new methods have increased pregnancy rates in beef and dairy cattle by ~50%. Five workshops have been conducted since 2002 in Kansas, Kentucky, Nebraska, Nevada, and Texas to transfer this technology to ~1000 producers, veterinarians, and county/state Extension workers. The value of this increase is estimated to save beef and dairy producers in the United States ~\$1 billion per year. (NC-1006: Methods to increase reproductive efficiency in cattle)

KNOWLEDGE AREA 301: REPRODUCTIVE PHYSIOLOGY (CONTINUED)

Diet Influences Gender of Offspring:

Research with bovine embryos at the **University of Missouri** revealed that when cultured in the presence of glucose, ~50% fewer female embryos than male embryos make the transition from morula to expanded blastocyst. In another study, ewes that were fed a high energy diet during the period of conception produced proportionately more male lambs than female lambs when compared to ewes on a control diet. Thus, producers may be able to bias the sex of the offspring born to sheep (and by analogy to cattle) by careful control of the diet during the time immediately preceding breeding. (NRI grant; CRIS Accession Number 0189641)

Supplemental Progesterone May Alleviate Early Embryonic Loss:

Lactating dairy cows that are pregnant at day 30 after breeding have been shown to lose 11-13% of pregnancies before day 60. If this early embryonic loss could be avoided, producers would save \$200-300 per cow. Research at **West Virginia University** has shown that if circulating concentrations of progesterone are low at day 30, embryonic losses are higher. Administration of supplemental progesterone to cows during the period of placentation and embryonic attachment may alleviate early embryonic losses. (NRI grant; CRIS Accession Number 0192783)

New Method to Superovulate Gilts: There are no methods for repeatable superovulation in swine. Studies conducted at the **University of Illinois** have identified the appropriate concentration of gonadotropins to increase ovulation rate in gilts. The researchers also developed a slow-release compound to minimize the number of times that animals were injected with gonadotropins resulting in increased ovulation rates and induced estrus in a similar manner as frequent injections of gonadotropins. This technology has improved the number and quality of oocytes and embryos produced from pigs for further studies of assisted reproductive techniques. (Hatch; CRIS Accession Number 0184417)

New Method to Cryopreserve Bull Sperm:

Scientists at **Colorado State University** have developed technologies to alter the membrane of bull sperm to enhance the ability of these cells to survive cryopreservation resulting in increased fertility. Addition of cholesterol-loaded cyclodextrin to ejaculates of semen improved the percentages of motile and viable sperm cells after freezing as well as fertility by more than 10%. This technology is being transferred to commercial bull studs to increase fertility rates from fewer sperm per artificial insemination. (NRI Grant; CRIS Accession Number 0187247)

Endocrine Control of Cystic Ovaries:

Cystic ovaries are the most common reproductive disorder in dairy cows in the United States. Approximately 15% of dairy cows develop ovarian follicular cysts during each lactation. Current treatments are only effective in half of the cases and each occurrence costs dairy farmers approximately \$137. Research at the **University of Kentucky** studied the causes of ovarian follicular cysts in dairy cows. There was no difference in adrenal function between normal and cystic cows; thus, it is unlikely that stress contributes to the formation of ovarian follicular cysts. Intermediate progesterone during the follicular phase of the estrous cycle may contribute to cyst formation by blocking the estradiol-induced LH surge. (NRI grant; CRIS Accession Number 0185567)

Activin Influences Ovarian Gene Expression:

Investigators at **Cornell University** showed that treatment of granulosa cells from small or large follicles with activin-A increased expression of mRNA for the inhibin-beta-B subunit, FSH receptor, and LH receptor, suggesting that theca-derived activin may regulate development of granulosa cells in hens. A better understanding of the molecular events associated with ovarian follicular growth and development and ovulation is essential to maximizing reproductive efficiency in turkeys and broiler breeder hens where egg production is not optimal. (NRI grant; CRIS Accession Number 0185559)